

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

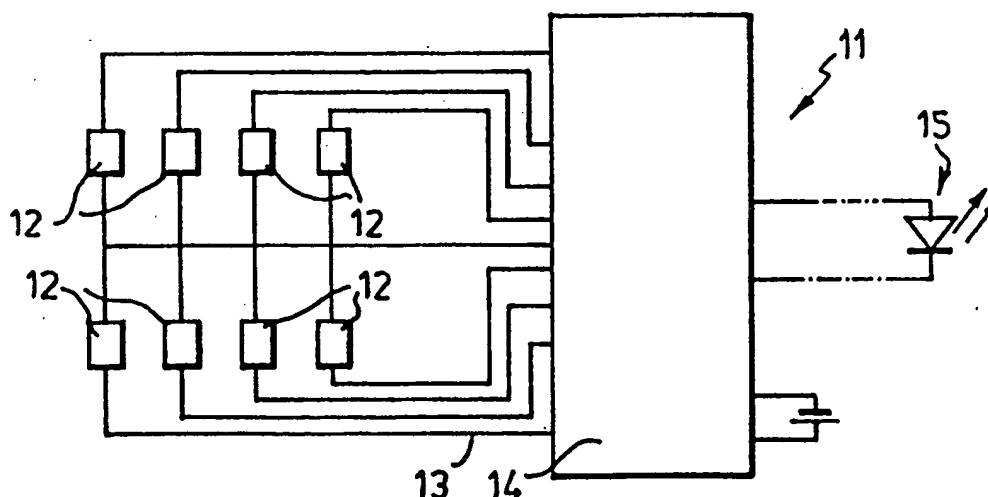
IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G01N 33/00		A1	(11) International Publication Number: WO 95/32422
			(43) International Publication Date: 30 November 1995 (30.11.95)
(21) International Application Number: PCT/GB95/01172 (22) International Filing Date: 23 May 1995 (23.05.95) (30) Priority Data: 9410411.4 23 May 1994 (23.05.94) GB (71) Applicant (for all designated States except US): AROMAS-CAN PLC [GB/GB]; Electra House, Electra Way, Crewe, Cheshire CW1 1WZ (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): McNEIGHT, David, Leslie [GB/GB]; Brow Top, Lees Lane, Wilmslow, Cheshire SK9 2LR (GB). PAYNE, Peter, Alfred [GB/GB]; 13 Chelworth Manor, Manor Road, Bramhall, Cheshire SK7 3LX (GB). PERSAUD, Krishna, Chandra [GH/GB]; 65 Mersey Bank Avenue, Chorlton, Manchester M21 7NT (GB). (74) Agents: McNEIGHT, David, Leslie et al.; McNeight & Lawrence, Regent House, Heaton Lane, Stockport, Cheshire SK4 1BS (GB).		(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: SENSOR



(57) Abstract

There is disclosed a sensor comprising a plurality of electric circuit elements sensitive to different substances, an electric circuit including said elements and circuitry in said circuit responsive to the condition of said circuit elements and connected to an output device, said circuitry being adapted to actuate the output device in response to one or more combination of conditions of the individual circuit elements.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

- 1 -

SENSOR

This invention relates to sensors.

Sensors for gases or vapours (hereinafter "gases") are known in which a substance whose electrical properties are changed on exposure to a particular gas or gaseous mixture is included as a circuit element with circuitry measuring one or more of its electrical properties such for example as resistance. A typical substance is a semiconducting polymer such as a poly- pyrrole.

It is known to use a plurality of such circuit elements of different substances that react differently to different gases or gaseous mixtures - any one substance may react to several different gases or gaseous mixtures, but a plurality of different substances will collectively react in different ways to different gases or gaseous mixtures facilitating differentiation.

Sensors of this kind are mounted in an arrangement through which a sample can be passed, a sampling system being connected to the duct to sample the air from, say, bottle or drum containing it. The sensor array is connected to a computer which has a

- 2 -

software-configured neural net which can be trained to identify gases or mixtures by exposure to known gases or mixtures and adjustment of its hidden units to produce the correct response. Clearly, a hardware-configured neural net can be developed for such an arrangement.

Such sensor arrangements are suitable for laboratory use and there is clearly scope for producing a range of specially designed instruments that can be adapted for use in different working environments. The computing power required, however, when enough different sensors are employed for most purposes, and the sampling arrangements involve a certain level of expense, and, of course, impose certain restrictions on the way in which the arrangements can be used.

There are circumstances where such equipment is too expensive and difficult to use, yet where the ability to detect certain gases or mixtures would be highly desirable. One such circumstance is in the detection of gases arising from microbiological activity, e.g. certain pathological conditions such as necrosis or infection in wounds. The wound dressing would ordinarily prevent access for a probe.

There are, however, many other circumstances such as fermentation monitoring in the brewing industry.

- 3 -

The present invention provides a sensor which can be used in such situations and which despite utilising the technology of the expensive arrangements currently available is a low cost, easy to use item.

The invention comprises a sensor comprising a plurality of electric circuit elements sensitive to different substances, an electric circuit including said elements and circuitry in said circuit responsible to the condition of said circuit elements and connected to an output device, said circuitry being adapted to actuate the output device in response to one or more combinations of conditions of the individual circuit elements.

One or more of said electric circuit elements may comprise a semiconducting polymer.

Said circuit may be comprised on a support on which said circuit elements are exposed.

A power source for said circuit may be carried on the board - a hearing aid battery or like sized battery, for example.

Said output device may comprise a two state indicator - it may not be important to know precisely

- 4 -

what has been detected, merely that something, one or more of several gases has been detected.

Such a two state indicator may have a power-on and a power-off state - a light emitting diode (led) for example - and while it might be desired to have a lamp such as an led light up to indicate an alarm condition, it might be desired as a fail-safe measure to have the light normally on as an indication that the sensor is functioning - a separate battery state indicator could, however, be provided. The output device may be latched so as to indicate a condition has arisen even after that condition has changed.

For a wound condition sensor, the elements will be sensitive to gases indicative of a pathological condition or infection and may be designed to be accommodated in a wound dressing with the output device exposed. The output device may be on an extension from said circuit, which may be a trailing lead, which may also carry a power source for the circuit, enabling the in-dressing component to be smaller and facilitating battery change.

Embodiments of sensors according to the invention will now be described with reference to the accompanying drawings, in which :-

- 5 -

Figure 1 is a diagrammatic illustration of the circuit of one embodiment;

and Figure 2 is a perspective view of a sensor embodying the circuit of Figure 1.

The drawings illustrate a sensor 11 comprising a plurality of electric circuit elements 12 sensitive to different substances, an electric circuit 13 including said elements 12 and circuitry 14 in the circuit 13 responsive to the condition of said circuit elements and connected to an output device 15, said circuitry 14 being adapted to actuate the output device in response to one or more combinations of conditions of the individual circuit elements.

One or more of said circuit elements may comprise a semiconducting polymer, such as a polypyrrole. A set of different such polymers may be used, reacting differently to different gases or to humidity so that any one combination of reactions is indicative of the presence of a single gas.

The circuit 13 is comprised on a support 16 on which the circuit elements 12 are exposed. As seen in Figure 2, the circuit elements 12 are under a permeable cover member 17, such for example as a wire or plastic

- 6 -

or textile gauze or a semipermeable membrane primarily to keep the elements 12 dry. The support 16 need be only, say, 2 x 4 cm in width and length, and no more than 1 cm in depth whereby it can easily be accommodated inside a wound dressing or a plaster cast. Even a power source in the form of a hearing aid battery or like small battery can be accommodated in such a support.

The output device 15 is a light emitting diode (led) which is a simple two state indicator, being either on or off. It might be desired to use a red led which illuminates to indicate the presence of a gas arising from an infection or other condition being monitored, but it may be preferred to have, say, a green led which in its on state indicated that the battery is working and no alarm condition is detected. An alarm condition might be indicated either by the led being in its off state (which might also indicate a battery change) or flashing.

In case it should be desired to indicate any transient alarm condition, the output device 15 may be latched so as to indicate that such a condition has arisen even after that condition has changed.

- 7 -

The elements 12 are sensitive to substances indicative of a pathological condition and the sensor 11 is adapted to be accommodated in a wound dressing with the output device 15 exposed. Whilst an output device 15 in the form of an led may be able to project between the wraps of a bandage, for larger dressings and plaster casts, where the wound may be deep within the dressing or cast, the output device 15 is on an extension from said circuit 13 in the form of a trailing lead 18. The led 15 is accommodated in a holder 19 which might also be adapted to hold a larger battery than could be held in the support 16 and that could be changed without undue disturbance to the dressing or the patient.

The support 16 could be a thin flexible substrate which could have the circuit 13 and the elements 12 and a semipermeable covering membrane printed or otherwise deposited on it, and such an arrangement would be capable of conforming to the bandaging and be more comfortable than a rigid sensor.

A liquid crystal display output member would consume less power than an led and might itself also be printed on a flexible substrate, yielding an inexpensive, disposable sensor eliminating any risk of cross-infection and the requirement for sterilising more expensive devices that have to be reused.

- 8 -

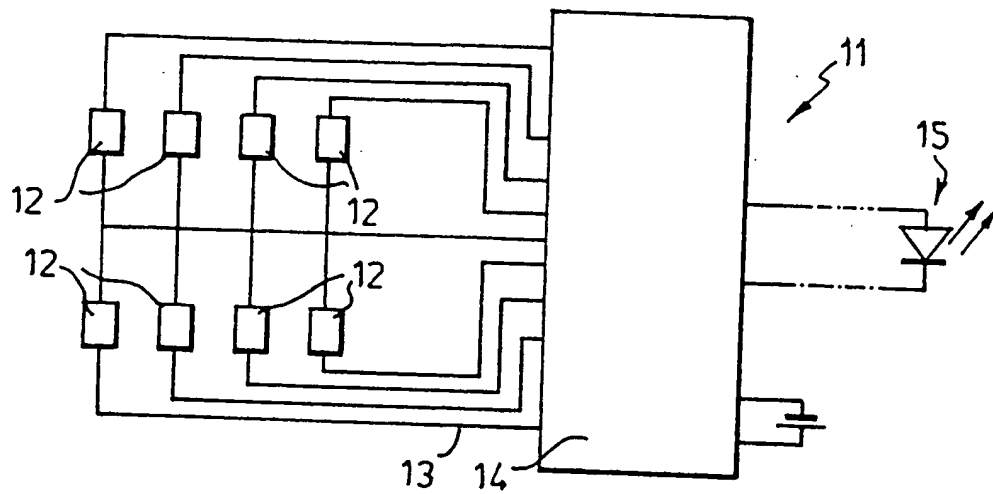
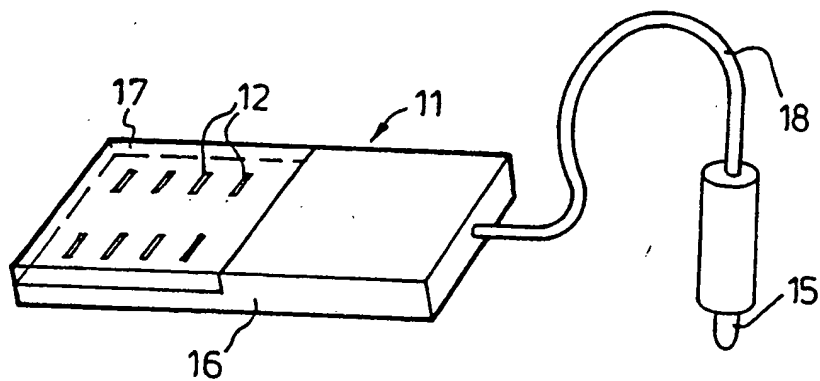
It will be appreciated that it is not intended to limit the invention to the above example only, many variations, such as might readily occur to one skilled in the art, being possible, without departing from the scope thereof as defined by the appended claims.

CLAIMS

1. A sensor comprising a plurality of electric circuit elements sensitive to different substances, an electric circuit including said elements and circuitry in said circuit responsive to the condition of said circuit elements and connected to an output device, said circuitry being adapted to actuate the output device in response to one or more combinations of conditions of the individual circuit elements.
2. A sensor according to claim 1, in which one or more of said electric circuit elements comprises a semiconducting polymer.
3. A sensor according to claim 1 or claim 2, in which said circuit is comprised on a support on which said circuit elements are exposed.
4. A sensor according to claim 3, comprising a power source for said circuit.
5. A sensor according to any one claims 1 to 4, in which said output device comprises a two state indicator.
6. A sensor according to claim 5, in which said two state indicator has as power-on and a power-off state.

7. A sensor according to claim 6, in which on actuation by said circuitry to indicate an alarm condition said indicator changes from its power-on to its power-off state.
8. A sensor according to any one of claims 1 to 7, in which said output device comprises a lamp such as a light emitting diode.
9. A sensor according to any one of claims 1 to 8, in which said output device is latched so as to indicate that a condition has arisen even after that condition has changed.
10. A sensor according to any one of claims 1 to 9, in which said elements are sensitive to substances indicative of a pathological condition and is adapted to be accommodated in a wound dressing with the output device exposed.
11. An sensor according to any one of claims 1 to 10, in which the output device is on an extension for said circuit.
12. A sensor according to claim 11, in which said extension is a trailing lead.
13. A sensor according to claim 11 or claim 12, in which a power source for said circuit is also on said extension.

1 / 1

FIG. 1FIG. 2

PCT/GB 95/01172

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01N33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,93 03355 (NEOTRONICS LIMITED) 18 February 1993	1,2
Y	see the whole document	3-9
Y	US,A,4 250 737 (BIGLIN) 17 February 1981	3-9
A	see the whole document	11-13
Y	US,A,4 327 361 (BERLIN) 27 April 1982	9
Y	see the whole document	
A	FR,A,2 381 314 (AUERGESELLSCHAFT GMBH) 15 September 1978	1-9, 11-13
A	see the whole document	
A	US,A,3 832 629 (CERNEK, JR.) 27 August 1974	4-9
A	see the whole document	
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

11 October 1995

Date of mailing of the international search report

13.10.95

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Bosma, R

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>PROCEEDINGS OF THE ELECTRONIC COMPONENTS CONFERENCE, ATLANTA, MAY 10-12, 1982, vol. conf. 32, 1982 NEW YORK, IEEE, US, pages 290-295, HIDEO ARIMA, ET AL. 'NEW CITY GAS DETECTOR USING A THICK FILM HYBRID SENSOR' see figures 14,15</p> <p>-----</p>	1-9, 11-13

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9303355	18-02-93	CA-A- 2113544 EP-A- 0596973 JP-T- 6509869	18-02-93 18-05-94 02-11-94
US-A-4250737	17-02-81	GB-A- 2048487	10-12-80
US-A-4327361	27-04-82	NONE	
FR-A-2381314	15-09-78	DE-A- 2707569 GB-A- 1593955 US-A- 4196428	24-08-78 22-07-81 01-04-80
US-A-3832629	27-08-74	NONE	